[0086] Loading surface **1000** reduces a height of passage **1004** and of a loading portion **1012** of reservoir channel **1002**. Preferably, the height of passage **1004** and loading portion **1012** is from about 25% to about 75%, such as about 50% of a height of first and second channels **1006, 1008** and of a height of a distal portion **1014** of reservoir **1002**.

[0087] To load valve **1001**, an amount of TRS is introduced through a hole **1015** until a leading edge of the TRS reaches edge **1016** of loading surface **1000**. Heat sources **1020** and **1021** are used to raise the temperature of reservoir **1002** and passage **1004** to a temperature sufficient to allow the TRS to flow. Upon reaching edge **1016**, capillary action draws the TRS into loading portion **1012** and passage **1004**. Upon reaching first and second edges **1017** and **1018**, surface tension substantially prevents the TRS from entering first and second channels **1006, 1008**. When a portion of the TRS contacts surface **1019** of protrusion **1010**, as shown in **FIG. 12***b,* the valve is in the closed state to substantially prevent the passage of material between first and second channels **1006, 1008**.

[0088] To open valve **1001**, the temperature of the TRS obstructing passage **1004** is raised to a temperature sufficient to allow at least a portion of the TRS obstructing the passage **1004** to disperse or melt and enter at least one of first and second channels **1006, 1008**. Pressure, such as air or liquid pressure, from one of the first and second channels preferably displaces the TRS obstructing the channel once the temperature has been raised. During the opening operation, the temperature of the TRS in the reservoir is preferably not raised by an amount sufficient to disperse or melt the TRS. Valve **1001** can be returned to the closed state by heating TRS present in reservoir **1002**. Capillary action will draw the TRS into passage **1004**, as discussed above.

[0089] Valve **1001** can be opened and closed repeatedly as long as an amount of TRS remains in the distal portion of reservoir **1002**. The amount of TRS present in the distal portion of the reservoir is preferably greater than the amount of TRS that was dispersed upon opening the passage. Preferably, the dispersed TRS enters one of the first or second channels. The amount of TRS in the distal portion of the reservoir is preferably at least slightly greater than the amount of TRS in the loading portion to ensure that the TRS will fully re-close passage **1004**.

[0090] The mean radius of curvature (MRC) of a distal end of TRS within the distal portion **1014** of reservoir **1002** is preferably greater than the MRC of a proximal end of TRS within the loading portion **1000** or within the passage **1004**. By distal, it is meant that portion of the TRS that is spaced apart from passage **1004,** by proximal it is meant that portion of the TRS that is adjacent or within passage **1004**. Preferably, the contact angle of the TRS with walls of the loading portion is substantially constant.

[0091] Valve **1001** can also include an opposing surface, such as that shown in **FIGS. 11***a***-11***d,* to assist in preventing the passage of material when the valve is in the closed state. Valve **1001** can also be configured as a non-capillary assisted loading valve in which loading surface **1000** is absent.

[0092] A constant channel width is not required. Thus, channels of varying width may be used. The tendency of a TRS to move in a given direction is governed by the ratio between the mean radius of curvature of the front of the drop and the mean radius of curvature of the back of the drop. These curvatures are based on the contact angle of the fluid with the material and the dimensions of the channel.

[0093] Returning to **FIG. 1**, the structure and operation of microfluidic system **700** is discussed in further detail. Chamber **704**, defined in substrate **701**, is preferably configured to perform at least one chemical or physical process using material therein. Material includes samples and reagents such as, for example, fluids, particles, such as cells, DNA, viruses, and particle containing fluids. In one embodiment, chamber **704** can be configured to mix a sample with a reagent to facilitate a chemical reaction. Alternatively, chamber **704** can be configured to concentrate or dilute a sample. Other processes, such as PCR amplification, filtering, and the like are also possible. It should be understood that chamber **704** can have the same dimensions as a channel.

[0094] An outlet channel **710** is provided as an outlet to remove excess sample or reagent materials from chamber **704**. During operation of chamber **704**, a valve **712**, is operated in the open state to allow material to exit chamber **704** via channel **710**. Preferably, channel **710** includes a flow through member, such as a filter, to allow only selected material to exit chamber **704** via channel **710**. A valve **714** prevents material within chamber **704** from entering a downstream channel **716**. A valve **718** prevents material within chamber **704** from entering an on-board pressure source **720**, which is preferably a thermally actuated type, as discussed above. Pressure source **720** preferably provides a sufficient gas pressure and gas volume to drive material present in chamber **704** into downstream channel **716**.

[0095] Upon completion of any process carried out within chamber **704**, valve **712** is closed to prevent any material from exiting chamber **704** via channel **704**. To allow material to enter downstream channel **716**, pressure source **720** and heat sources associated with valves **714** and **718** are actuated thereby opening both valves. Material is transported through a passage of valve **714** into downstream channel **716** for analysis or further processing. Downstream processing chambers preferably include chambers to lyse cells, such as bacterial cells. Example bacteria include Group B streptococcus and bacteria associated with bacterial menengitis. Cells can be lysed to release nucleic acids therein, as known in the art by contacting the cells with a lysing agent, such as a surfactant and/or buffer. Thus, the system is preferably provided with a reservoir of buffer connected by a channel to the lysing chamber. A second downstream processing chamber is preferably configured to perform a PCR reaction upon nucleic acids released from the lysed cells. The PCR chamber is joined by channels configured to introduce reagents, such as enzymes and buffers suitable to facilitate the amplification of the nucleic acids.

[0096] The opening and closing of the valves herein preferably operate automatically under computer control. System **700** preferably includes contacts **720**, which provide electrical or optical communication with various on-board system elements, such as valves, heaters, procession chambers, sensors to detect the state of valves, and the like. Preferred computer control systems and methods for operating thermally actuated valves are disclosed in U.S. patent application Ser. No. 09/819,105 filed Mar. 28, 2001, which is hereby incorporated herein in its entirety.